LOW RISK QUANTIFIERS: A GAME-THEORETICAL APPROXIMATION TO THE DP-RESTRICTION ON IV2-PRESENTATIONALS

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Low risk quantifiers (LRQs) are quantifiers for which an opponent has no superior falsification strategy in a GTS-style verification game. LRQs are shown to closely approximate the class of DP-quantifiers allowed in a presentational construction of German involving prosodically and information-structurally integrated V2 clauses. The notion of "risk" will be linked to a speaker strategy in competitive argumentation.

1. The DP-Restriction on IV2-Presentationals

German IV2-Presentationals (IV2Ps) have been discussed by Gärtner (2001; 2002), and Endriss & Gärtner (2005). The hallmark of IV2Ps, illustrated in (1a), is a Verb Second (V2) clause that is prosodically and information-structurally integrated into the preceding (matrix) clause and contains a fronted weak demonstrative. These characteristics make IV2Ps a hybrid of syntactically integrated relative clauses, (1b), which are verb final in German, and sequences of non-integrated main clauses, (1c).

(1) a. *Henk kennt viele Linguisten, (/) die arbeiten an Spieltheorie*
"Henk knows many linguists who work on game theory"
b. *Henk kennt viele Linguisten, (/) die an Spieltheorie arbeiten*
c. *Henk kennt viele Linguisten. (\) Die arbeiten an Spieltheorie*

IV2Ps, (1a), and restrictive relatives, (1b), differ from main clause sequences, (1c), in that the former two restrict the range of *viele* ("many") to counting linguists working on game theory, while (1c) expresses the claim that Henk is acquainted with many linguists, all of whom work on game theory.

Importantly, the class of DPs that can be "IV2P antecedents," i.e. occur in the first clause as antecedent of the demonstrative or as modifiee of an IV2P, is restricted. Thus, note the impossibility of negative and universal quantifiers in (2a), which IV2Ps share with main clause sequences, (2c), but not with restrictive relatives, (2b).

(2) a. * *Henk kennt keinen/jeden Linguisten,* (/) *der arbeitet an Spieltheorie*
"Henk knows no/every linguist who works on game theory"
b. *Henk kennt keinen/jeden Linguisten,* (/) *der an Spieltheorie arbeitet*
c. *Henk kennt keinen/jeden Linguisten*. (\) * *Der arbeitet an Spieltheorie*

(3) provides the core list of determiners heading IV2P antecedents, (3a), and determiners incompatible with IV2P, (3b).

(3) a. *ein* ("a"/"one"), *zwei/drei/.../n* ("two"/"three"/.../*n*), *einige* ("some"), *mehrere* ("several"), *viele* ("many"), *mindestens n* ("at least *n*"), *genau n* ("exactly *n*")
b. *der* ("the"), *jeder* ("every"), *alle* ("all"), *die meisten* ("most"), *kein* ("no"), *wenige* ("few"), *höchstens n* ("at most *n*")

2. Low Risk Quantifiers

The main point of this paper is the claim that game-theoretical semantics (GTS) can be adapted in such a way that a very close approximation to the quantifier classification in (3) results. For this purpose, let us look at utterances *u* of minimal sentences [α β] where α is a DP-quantifier and β an operator-free one-place predicate. For any such utterance *u* take the speaker, S, to be the "proponent" (or "verifier") and the hearer, H, to be the "opponent" (or "falsifier") in the verification game for *u*. Then,

(4) A DP-quantifier α is a *low risk quantifier* if there is no superior falsification strategy for H in the verification game for *u* containing α

If a DP-quantifier is not a low risk quantifier (LRQ), it is a *high risk quantifier* (HRQ). Superiority of strategies will be discussed in section 3. (5) and (6) provide strategies for the most straightforward HRQs and LRQs, respectively.

(5) High risk quantifiers (– IV2P antecedents)

a. *kein(P)(Q)*:	H presents $a \in P \cap Q$
b. *jeder(P)(Q)*:	H presents $a \in P - Q$
c. *der(P)(Q)*:	H presents $a \in P$ for $a \neq b$ after S has presented $b \in P \cap Q$
d. *höchstens_n(P)(Q)*:	H presents $R' \subseteq P \cap Q$ for $R' \cap R = \varnothing$ and $\lvert R' \rvert + \lvert R \rvert > n$ after S has presented $R \subseteq P \cap Q$ for $\lvert R \rvert \leq n$

(6) Low risk quantifiers (+ IV2P antecedents)

a. *ein(P)(Q)*: S presents $a \in P \cap Q$

b. *einige(P)(Q)*: S presents $R \subseteq P \cap Q$ for $|R| \geq 2$

c. *n(P)(Q)*: S presents $R \subseteq P \cap Q$ for $|R| = n$

d. *mindestens_n(P)(Q)*: S presents $R \subseteq P \cap Q$ for $|R| \geq n$

This already covers the majority of non IV2P antecedents, (3b), and IV2P antecedents, (3a), respectively.[1] The rules just given are closely related to Hintikka's original game rules for GTS (cf. Saarinen 1979) and their extensions to generalized quantifiers (Clark 2007; Pietarinen 2007).

The treatment of *die meisten* ("most") in (7) follows the automata-theoretic characterization of *most* by van Benthem (1987) in providing a falsification strategy for H. This makes *die meisten* an HRQ in accordance with its status as non IV2P antecedent.

(7) *die_meisten(P)(Q)*: For each (new) $a \in P \cap Q$ presented by S, H presents a (new) $b \in P - Q$

For the treatment of *viele* ("many") as an LRQ, I suggest strategy (8).

(8) *viele(P)(Q)*: S presents $R \subseteq P \cap Q$ for $|R| > \mu$

μ is a placeholder for the various thresholds involved in the various construals of *many*. The important point is that once S makes a choice of a set of individuals, it is quite unclear how H could falsify S's claim by counterexamples, given the general vagueness and context dependence of *many*. In order to capture the fact that *wenige* ("few") is not an IV2P antecedent, I suggest that its high risk nature lies in the possibility for H to apply the strategy open to S in the case of *many*.[2]

(9) *wenige(P)(Q)*: H presents $R \subseteq P \cap Q$ for $|R| > \mu$

3. Previous Accounts

We have seen that – with the exception of *genau n* ("exactly *n*")[3] – the distinction

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[1] Strategies for *alle* and *mehrere* match the ones for *jeder* and *einige*, and are thus omitted.

[2] Alternatively one could assume that "H presents $R' \subseteq P \cap Q$ after S has presented $R \subseteq P \cap Q$ for $|R| \leq \varphi$, such that $R' \cap R = \varnothing$, and $|R| + |R'| > \varphi$" (φ = the threshold placeholder for *few*).

[3] The rule "H presents $a \in P \cap Q$ for $a \notin R$ after S has presented $R \subseteq P \cap Q$ for $|R| = n$" makes it an HRQ.

between LRQs and HRQs adequately captures the classes of +/– IV2P antecedents. Apart from being an intrinsically interesting excercise in quantifier classification,[4] the LRQ-approach constitutes an advance over previous accounts of the DP-restriction on IV2Ps. Its first merit is uniformity. Each previous account had to rely on (at least) two distinct principles to achieve a satisfactory classification. Gärtner (2001) requires the weak demonstratives in IV2Ps to pick up an accessible discourse referent in the sense of Kamp & Reyle (1993). In order to rule out definite antecedents, an incompatibility of V2-clauses with the definite's presupposition had to be added. Endriss & Gärtner (2005) require the DP antecedents (i) to be "topical" in the sense of Endriss (2006), based on the notion of minimal witness-set (cf. Szabolcsi 1997)[5], and (ii) to allow for information-structural assignment of quantificational restrictor and nucleus in the sense of Herburger (2000). (i) filters out weak determiners like *kein* ("no"), *höchstens n* ("at most *n*"), and *wenige* ("few") while (ii) rules out universal *jeder* ("every"), definite *der* ("the") and *die meisten* ("most"). The second merit is empirical coverage. While the approach by Gärtner (2001) is not worked out enough to allow broader comparison[6], the more explicit theory of Endriss & Gärtner (2005) misclassifies both *mindestens n* ("at least *n*") and *genau n* ("exactly *n*") [!] as non IV2P antecedents.[7]

If we extend empirical coverage further, the LRQ-approach yields a mixed picture. First, to the extent that rules (8)/(9) can be upheld for *many/few*, a variant of them can be used to charecterize *fast alle* ("almost all") and *fast keine* ("almost no") as HRQs. H would have to present $R \subseteq P\text{–}Q$ and $R \subseteq P \cap Q$ for $|R| > \mu$, respectively. And in fact, neither *fast alle* nor *fast keine* is an IV2P antecedent.

On the other hand, a treatment of *nicht alle/nicht jeder* ("not all"/"not every") as HRQ demands the additional assumption that for a quantifier α to count as LRQ, S must not be

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[4] In terms of Barwise & Cooper (1981:219) we are dealing with [+weak]/[–↓] or [+weak]/[–antipersistent].

[5] The "topic condition" itself contains two clauses, requiring that a generalized quantifier be replaceable (modulo some type-shift) by a minimal witness set (i) *salva veritate* and (ii) without loss of anaphoric possibilities (Endriss 2006:253).

[6] In this system, set referents introduced by abstraction and summation and picked up by plural anaphors (Kamp and Reyle 1993: chapter 4) have to be ruled out as accessible in IV2Ps in order to prevent serious overgeneration. Also, an account for modal subordination failure is required (Gärtner 2002). The integrated nature of IV2Ps seems to require anaphora resolution to precede operations like abstraction and accommodation (cf. Kamp and Reyle 1993: section 4.4.4).

[7] Endriss (2006) hints at the possibility of accounting for the behavior of *mindestens n* by assuming that *mindestens* is not part of the quantifier here but functions as a focus operator. However, it is unclear why the same reanalysis couldn't apply to *höchstens n* too, which would thereby be ruled in incorrectly.

forced to assume the role of falsifier during the verification game for *u* of a minimal sentence [α β] (as characterized above). Recall that the GTS game rule for *not* reverses the roles of verifier and falsifier for the ensuing subgames (Pietarinen 2007:184).

4. GTS and Risk

The LRQ-approach differs from standard GTS in the following respects. First, the GTS-rule for *most* – adapted in (10) – would incorrectly make *die_meisten* an LRQ.

(10) *most(P)(Q)*: S presents $R \subseteq P \cap Q$ for $|R| > P/2$

However, the existence of (10) does not invalidate the classification of *most* as an HRQ, given that (10) co-exists with (7). This is where the notion of superiority in the definition of LRQ comes in. Verification strategy (10) is inferior to falsification strategy (7). This subtle point can be brought out by (11) as another viable alternative to (7).

(11) *most(P)(Q)*: H presents $R \subseteq P – Q$ for $|R| \geq P/2$

With reference to van Benthem (1986:208) one can define superiority in terms of ease of "refutation" vs. ease of "confirmation" wrt. numbers of individuals to be checked.[8]

As a second point of divergence, note the appeal to a "falsification strategy" in (4), as opposed to the standard "winning strategy" concept of GTS. The LRQ-approach aims at defining a particular class of quantifiers. This is independent of the standard GTS objective of giving truth conditions for languages with quantifiers, for which winning strategies (and reference to models) are crucial.

Finally, use of the notion "risk" is a deliberate attempt at bridging the gap between GTS and other branches of game theory influential in pragmatics (cf. Clark 2007; Jäger 2007). I speculate that risk is a factor in competitive argumentation games too. The intuition to be worked out is that the proponent of an IV2-Presentational is trying to secure the second move – use of the integrated V2 clause. An LRQ is the right choice then, because it will go unchallenged. Use of an HRQ, on the other hand, obliges the opponent to challenge S, who therefore risks not to be able to make the second move.

4. Conclusion

It has been shown that low risk quantifiers (LRQs), i.e. quantifiers for which an

[8] Apart from issues concerning infinite domains, this intuition also motivates GTS-rules like (5b) for *every* instead of something like "S presents $R \subseteq P \cap Q$ for $|R| = |P|$".

opponent has no superior falsification strategy in a GTS-style verification game, closely approximate the class of DP-quantifiers allowed in German IV2-Presentationals. The notion of risk has been linked to a speaker strategy in competitive argumentation.

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